PRINT HEAD CAP

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a print head cap for covering a nozzle surface therewith at the time of recovering a print head for ejecting ink droplets onto printing paper or at the time of keeping the print head moist.

Background Art

In the related art, as disclosed in JP-A-5-193150, there has been known a cap having a box-like sealing portion, a thick portion formed in the outer circumference of the sealing portion and a thin portion coupling the sealing portion with the thick portion. In order to improve the sealing performance of the cap pressed onto the nozzle surface of a print head, the cap is adapted so that the thin portion is deformed when the sealing portion is pressed onto the nozzle surface, so that the sealing portion is equalized and brought into tight contact with the nozzle surface.

In addition, as disclosed in JP-A-10-211711, the cap is formed into a rectangular box-like shape corresponding to the shape of the nozzle surface.

SUMMARY OF THE INVENTION

In such a related-art rectangular cap, particularly in such a cap for use in a full-line type print head in which a plurality nozzles are arrayed all over the width-direction area of printing paper, precision in flatness, dimensions and the like has to be high enough when the size of the print head in the direction in which the nozzles are arrayed is large and the cap is brought into tight contact with the nozzle surface uniformly. However, since the cap is formed out of an elastic body of rubber or the like, it is difficult to manufacture the cap particularly into such a high-precision shape. Thus, it is difficult to retain air-tightness required in the cap. In addition, since defective caps are often manufactured, there is also a problem that the yield in manufacturing deteriorates.

A print head cap is disclosed herein, in which air-tightness can be retained while the yield in manufacturing can be improved.

According to one aspect of the invention, a print head cap includes: a bottom surface; and a ring-like lip surrounding the bottom surface like a ring and protruding toward a nozzle surface of a print head of an ink jet printer and being elastically deformable, the ring-like lip to be pressed onto the nozzle surface to cover the nozzle surface therewith. The ring-like lip has corners that change a direction of surrounding the bottom surface. The corners are more elastically deformable than the

other portion of the ring-like lip.

According to another aspect of the invention, a print head cap includes: a bottom surface; and an elastically deformable lip surrounding the bottom surface like a ring and protruding toward a nozzle surface of a print head of an ink jet printer, the lip to be pressed onto the nozzle surface to cover the nozzle surface therewith. The lip has a plurality of side lips and a plurality of corner lips connecting the side lips with each other and changing a direction of surrounding the bottom surface. At least one of the plurality of corner lips is formed into an arc-like shape swelling outward and is formed to be lower in height than the side lips.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention may be more readily described with reference to the accompanying drawings:

Fig. 1 is a configuration diagram of a printer using a print head cap according to a first embodiment of the invention.

Fig. 2 is a plan view of a capping mechanism using the print head cap according to the embodiment.

Fig. 3 is a sectional view taken on line 3-3 in Fig. 2.

Fig. 4 is a plan view of the print head cap according to the embodiment.

Fig. 5 is a sectional view taken on line 5-5 in Fig. 4.

Fig. 6 is a sectional view taken on line 6-6 in Fig. 4.

Fig. 7 is a sectional view taken on line 7-7 in Fig. 4.

Fig. 8 is a plan view of a print head cap according to a second embodiment of the invention.

Fig. 9 is a sectional view taken on line 9-9 in Fig. 8.

Fig. 10 is a sectional view taken on line 10-10 in Fig. 8.

Figs. 11A and 11B are explanatory views showing the falling of a lip of the print head cap according to the second embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiments of the invention will be described below in detail with reference to the drawings.

As shown in Fig. 1, a printer according to this embodiment has a full-line type print head 1, and a large number of not-shown nozzles are formed in the print head 1 in a direction perpendicular to the direction of feeding printing paper. A nozzle surface 2 in which the nozzles are opened is disposed to be opposed to the printing paper.

In addition, the print head 1 is of an ink jet system for ejecting ink droplets onto the printing paper. For example, such a print head 1 is provided for respective colors of yellow, magenta, cyan and black. Incidentally, each part of the print head 1 is supplied with its corresponding color ink from an ink cartridge 4 through an ink supply mechanism 6.

The printing paper is fed in tight contact with the surface

of a belt 10 laid between a pair of rollers 8 (only one of which is shown). Each print head 1 is disposed in a body case 11 movably in a direction perpendicular to the surface of the belt 10 on which the paper is mounted. At the time of carrying out printing, the print head 1 is moved to an ink ejection position close to the printing paper as shown in Fig. 2. At the time of maintenance, the print head 1 is moved to a standby position in which a predetermined space is formed between the print head 1 and the printing paper and which is more distant from the belt 10 than the ink ejection position, as shown in Fig. 1.

A mounting base 12 which can be inserted into this space is provided. As shown in Fig. 3, the mounting base 12 is supported on a pair of guide bars 14 and 16 through a plurality of sliding members 18 so that the mounting base 12 can move forward/backward linearly. The guide bars 14 and 16 are disposed perpendicularly to the direction of feeding the printing paper (direction perpendicular to the paper surface of Fig. 1). A belt 19 is laid in parallel with the guide bars 14 and 16. The mounting base 12 and the belt 19 are fastened to each other through a lock member 20.

When the belt 19 is driven by a motor, the mounting base 12 slides along the guide bars 14 and 16 so that the mounting base 12 can move forward/backward between a maintenance position (position designated by the solid line in Fig. 1) in which the mounting base 12 is inserted into the space between the print

head 1 and the printing paper and a retraction position (position designated by the chain double-dashed line in Fig. 1) in which the mounting base 12 is retracted from the space to the upper side of the ink cartridge 4 at the time of printing.

A capping mechanism 22 is mounted on the mounting base 12. The capping mechanism 22 has a plurality of links 24 one ends of which are supported swingably on the mounting base 12, and a cap base 26 on which the other ends of the plurality of links 24 are supported swingably. The cap base 26 is configured as follows. That is, when the mounting base 12 is moved to the maintenance position, each engagement portion 28 integrated with the cap base 26 abuts against a fixed side provided in the print head 1 so as to keep the cap base 26 parallel with the nozzle surface 2 while being moved toward the nozzle surface 2 so as to describe an arc.

A swinging base 30 is supported on the cap base 26 swingably around a pin 32 as shown in Fig. 3. On each of opposite sides of the pin 32, a coil spring 33a, 33b is disposed between the cap base 26 and the swinging base 30. Four print head caps 34 (hereinafter referred to as "caps 34") are attached to the swinging base 30 correspondingly to the respective colors of the print head 1 in this embodiment. The caps 34 are formed out of an elastically deformable material, particularly a material resistant to ink, such as butyl rubber or EPDM.

A bottom surface 36 opposed to the nozzle surface 2 is

formed in the cap 34 as shown in Fig. 3. The bottom surface 36 is substantially flat, and an exhaust hole 38 opened in the bottom surface 36 is formed in the cap 34. The exhaust hole 38 is designed to be connected to a not-shown exhaust duct so as to be able to exhaust ink.

In each cap 34, a lip 40 is provided to surround the bottom surface 36 like a ring. The lip 40 protrudes toward the nozzle surface 2 of the print head 1. In this embodiment, the lip 40 has a pair of side lips 40a and 40b provided linearly along the long sides of the bottom surface 36, and a pair of side lips 40c and 40d provided linearly along the short sides of the bottom surface 36.

Each side lip 40a-40d is formed into a tapered shape having a sectional shape thicker on the bottom surface 36 side and thinner gradually as the location goes toward the front end of the side lip 40a-40d, as shown in Figs. 5 and 6. Incidentally, the shape of the side lip 40a-40d is not limited to the linear shape, but it may be a curved shape describing a gentle arc or the like.

Of the corners of the lip 40 in which the direction of surrounding the bottom surface 36 changes, in this embodiment, each corner in which the direction changes at the angle of 90 degrees from the side lip 40a, 40b along the long side to the side lip 40c, 40d along the short side connects the side lips 40a-40d with each other through a corner lip 40e-40h formed

out of an arc. The corner lip 40e-40h is formed to have the same height from the mounting surface S as the height of the side lip 40a-40d. In this embodiment, the corner lip 40e-40h is formed to have the same thickness in its sectional shape as that of the front end of the side lip 40a-40d as shown in Fig. 7. The corner lip 40e-40h is formed to be easier to be elastically deformable than the side lip 40a-40h. Figs. 4 and 6 shows the state of the lower side than the center line where the cap 34 has been pressed onto the nozzle surface 2 and thereby deformed. Incidentally, if the corner lip 40e-40h is thinner than the side lip 40a-40d, it will be easier to be elastically deformed, and then the embodiment can be carried out.

A groove 42 is formed all over the circumference outside the side lips 40a-40d and the corner lips 40e-40h. When each front end of the side lips 40a-40d and the corner lips 40e-40h is pressed onto the nozzle surface 2, the front end is urged to be deformed due to the groove 42 as shown in Fig. 6.

Incidentally, protrusions 44 and 46 for positioning the cap 34 when it is attached to the swinging base 30 are formed on the back surface of the cap 34.

Next, description will be made on the operation of the print head cap according to this embodiment.

At the time of printing, the belt 10 is driven by the rotations of the rollers 8 so that printing paper passes under the print head 1 at a fixed speed. Then, ink droplets are ejected

from the print head 1 so that printing is performed line by line.

At the time of maintenance for recovering the nozzles of the print head 1 from clogging or keeping the nozzles of the print head 1 moist, the print head 1 is moved from the ink ejection position to the standby position as shown by the arrow in Fig. 1 so that a predetermined space is formed between the print head 1 and the belt 10. Then, driven by the belt 19, the mounting base 12 is guided along the guide bars 14 and 16 and inserted into the space between the print head 1 and the belt 10.

When each engagement portion 28 abuts against the fixed side of the printer, and the mounting base 12 is moved further, the cap base 26 is moved to describe an arc from the separation position shown in Fig. 3 toward the nozzle surface 2 by the plurality of links 24 while retaining its parallelism with the nozzle surface 2. Then, the cap 34 is pressed onto the nozzle surface 2. In that event, the swinging base 30 swings around the pin 32 so as to press the cap 34 onto the nozzle surface 2 by uniform pressing force.

When the cap 34 is pressed onto the nozzle surface 2, each side lip 40a-40d is elastically deformed as if the front end thereof falls down to the inside of the groove 42 as shown in Fig. 6. Then, each corner lip 40e-40h is elastically deformed as if the front end of the corner 40e-40h falls down to the

inside of the groove 42 similarly. At the same time, the arc-like circumferential length of the corner lip 40e-40h connecting the front ends of the side lips 40a-40d on the opposite sides of the corner lip 40e-40h is elongated because the front ends of the side lips 40a-40d fall down to expand outward. Since the corner lip 40e-40h is formed to be easy to be elastically deformed, the corner lip 40e-40h expands in its circumferential direction.

Accordingly, when the cap 34 is pressed onto the nozzle surface 2, as shown in Figs. 4 and 6, the front ends of the side lips 40a-40d fall down outward, and the front ends of the corner lips 40e-40h fall down outward while expanding in their circumferential directions respectively. Thus, the front ends of the side lips 40a-40d and the corner lips 40e-40h are brought into tight contact with the nozzle surface 2 so as to cover the nozzle surface 2 air-tightly with the bottom surface 36, the side lips 40a-40d and the corner lips 40e-40h.

After that, ink is ejected from the print head 1 for the sake of recovery of the nozzles or the like. In that event, since the nozzles are covered air-tightly with the bottom surface 36, the side lips 40a-40d and the corner lips 40e-40h, there is no fear that the ink leaks out. Incidentally, not only at the time of recovery but also at any time when printing is not carried out, the cap 34 is pressed onto the nozzle surface 2 so as to keep the nozzle surface 2 moist.

Since the corner lips 40e-40h are formed to be easy to be elastically deformed in such a manner, it is possible to retain air-tightness. In addition, since the corner lips 40e-40h are elastically deformed to retain the air-tightness, the tolerance for dimensional accuracy is so large that the number of caps 34 defective in dimensions can be reduced. Thus, the yield in manufacturing can be improved.

Next, description will be made on a print head cap according to a second embodiment different from the aforementioned embodiment, with reference to Figs. 8 to 10, 11A and 11B. Members the same as those in the aforementioned embodiment are denoted by the same reference numerals correspondingly, and their detailed description will be omitted.

As shown in Fig. 8, in a cap 50, a bottom surface 36 is formed to be opposed to the nozzle surface 2. The cap 50 is provided with a lip 52 surrounding the bottom surface 36 like a ring. The lip 52 protrudes toward the nozzle surface 2 of the print head 1. In this embodiment, the lip 52 has a pair of side lips 52a and 52b provided linearly along the long sides of the bottom surface 36, and a pair of side lips 52c and 52d provided linearly along the short sides of the bottom surface 36. Also in this case, the shape of the side lip 52a-52d is not limited to the linear shape, but may be a curved shape.

Each side lip 52a-52d is formed to have a sectional shape protruding obliquely from the bottom surface 36 side toward

the nozzle surface 2, and to have a front end opened to the outside so as to overhang the bottom surface 36, as shown in Figs. 9 and 10. The side lip 52a-52d is formed to have a substantially uniform thickness between the bottom surface 36 side and the front end side or a thickness reduced slightly as the location goes toward the front end.

Of the corners of the lip 52 in which the direction of surrounding the bottom surface 36 changes, in this embodiment, each corner in which the direction changes at the angle of 90 degrees from the side lip 52a, 52b along the long side to the side lip 52c, 52d along the short side connects the side lips 52a-52d with each other through each corner lip 52e-52h. The corner lip 52e-52h is formed into an arc-like shape swelling outside the corner where the extensions of the side lips 52a-52d cross each other, as shown in Fig. 8. As shown in Fig. 9 and 11A, the corner lip 52e-52h is formed to protrude obliquely further outside the side lip 52a-52d between the bottom surface 36 and its front end.

In addition, the corner lip 52e-52h is formed to be lower in height (height from the mounting surface S) than the side lip 52a-52d. The corner lip 52e-52h is formed to be the lowest at the intermediate point of its arc and to be inclined toward the front end of the side lip 52a-52d on either side so as to be equal in height to the side lip 52a-52d. The height of the corner lip 52e-52h may be determined by experiment or the like

so that the height of the corner lip 52e-52h becomes equal to that of the side lip 52a-52d due to the deformation of the cap 50 when the cap 50 is pressed onto the nozzle surface 2. Incidentally, Figs. 8 and 10 show the state of the lower side than the center line where the cap 50 has been pressed onto the nozzle surface 2 and deformed.

Next, description will be made on the operation of the print head cap according to this second embodiment.

When the cap 50 is pressed onto the nozzle surface 2, each side lip 52a-52d is elastically deformed as if it falls down outward as shown in Figs. 8, 10 and 11B. Thus, the height of the side lip 50a-50d is lowered. On the other hand, each corner lip 52e-52h falls down outward similarly together with the side lip 52a-52d on either side on the side lip 52a-52d side. The corner lip 52e-52h does not fall down very much in its intermediate portion. Thus, the height of the corner lip 52e-52h is not lowered.

Accordingly, when the cap 50 is pressed onto the nozzle surface 2, the height of the side lip 52a-52d and the height of the corner lip 52e-52h become substantially equal to each other so as to be brought into tight contact with the nozzle surface 2 with no space therebetween. Thus, the nozzle surface 2 is covered air-tightly with the bottom surface 36, the side lips 52a-52d and the corner lips 52e-52h.

In such a manner, the cap 50 is formed so that the side

lips 52a-52d are deformed to be equal in height to the corner lips 52e-52h. Thus, it is possible to retain air-tightness. In addition, since the air-tightness is retained due to deformation of the side lips 52a-52d, the tolerance for dimensional accuracy is so large that the number of caps 50 defective in dimensions can be reduced. Thus, the yield in manufacturing can be improved.

The invention is not limited to the embodiments described above, but it can be carried out in various modes without departing from the gist of the invention.

As has been described in detail above, the print head cap 34 and 52 according to embodiments of the invention is formed so that the corner lips 40e-40h and 52e-52h are easy to be elastically deformed. Thus, it is possible to retain air-tightness. In addition, since the air-tightness is retained due to the elastic deformation of the corner lips 40e-40h and 52e-52h, the tolerance for dimensional accuracy is so large that the number of defective caps in dimensions can be reduced. Thus, there is an advantage that the yield in manufacturing can be improved. Particularly, when a groove 42 is formed outside the lip 40, the elastic deformation is urged so that the air-tightness can be retained more surely.

In addition, in the print head cap 52, the side lips 52a-52d are deformed to have the same height as the corner lips 52e-52h, so that the air-tightness can be retained. In addition, since

the air-tightness is retained due to the deformation of the side lips 52a-52d, the tolerance for dimensional accuracy is so large that the number of defective caps in dimensions can be reduced. Thus, there is an advantage that the yield in manufacturing can be improved.

While the invention has been described in conjunction with the specific embodiments described above, many equivalent alternatives, modifications and variations may become apparent to those skilled in the art when given this disclosure. Accordingly, the exemplary embodiments of the invention as set forth above are considered to be illustrative and not limiting. Various changes to the described embodiments may be made without departing from the spirit and scope of the invention.